

# Software Development

- LAPS Workshop Oct 25-27, 2010
- More info (including Forum) at:  
<http://laps.noaa.gov>



# LAPS README

This LAPS/STMAS README file is viewable on the WWW via the LAPS home page

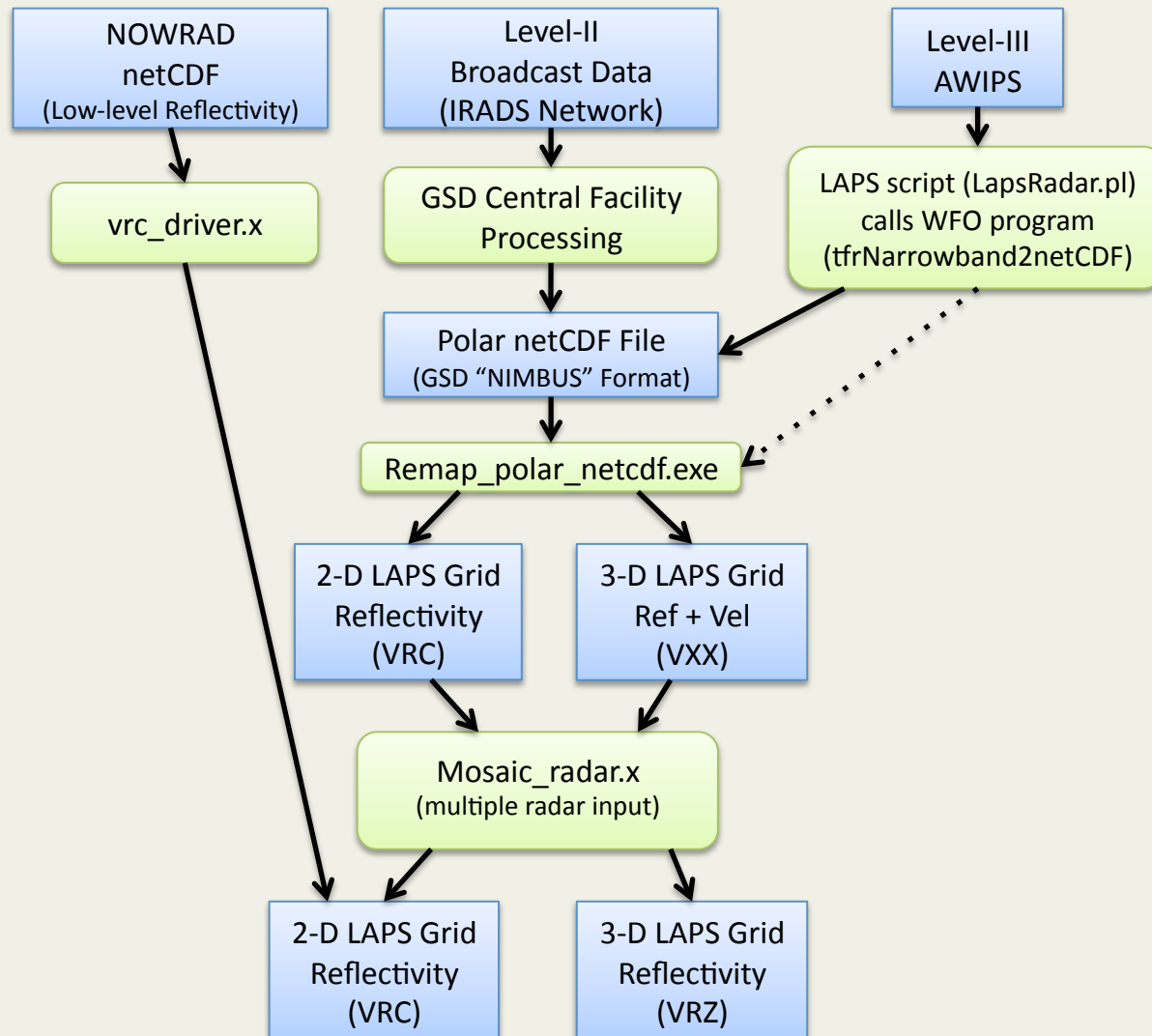
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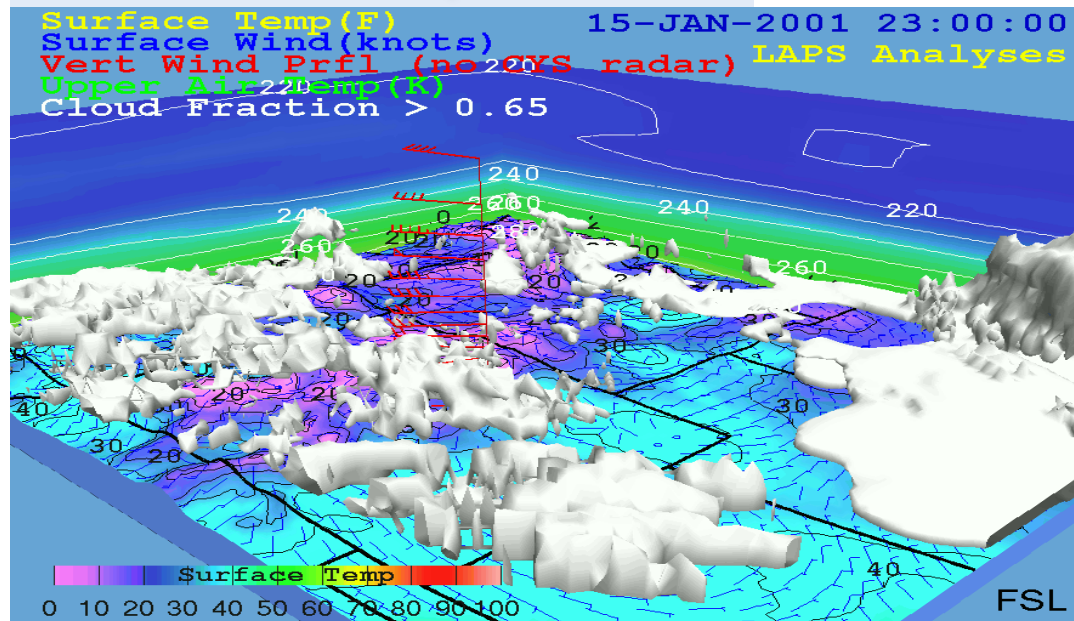


# LAPS Radar Ingest

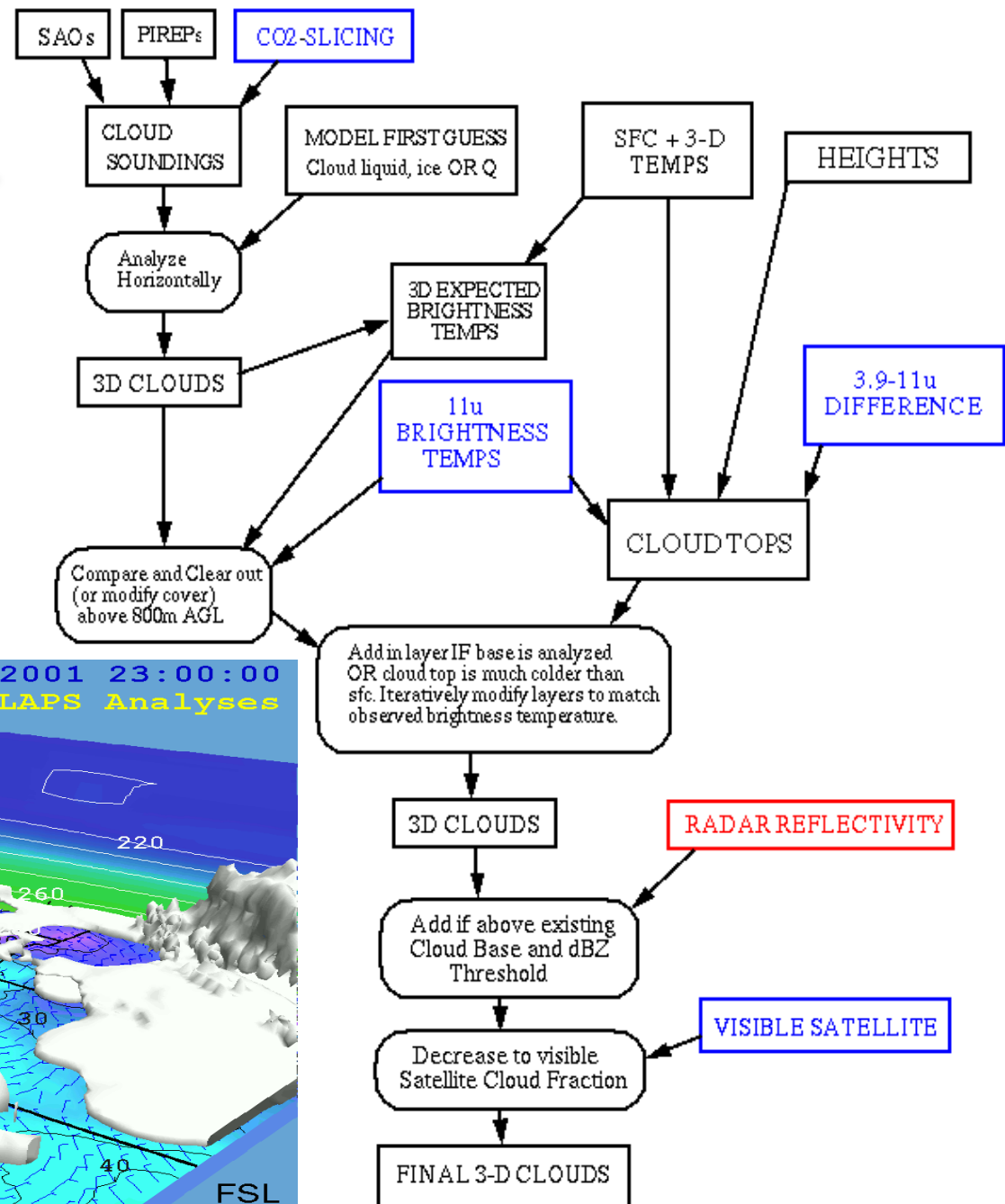


# Cloud Analysis (cloud.exe) Flow Chart

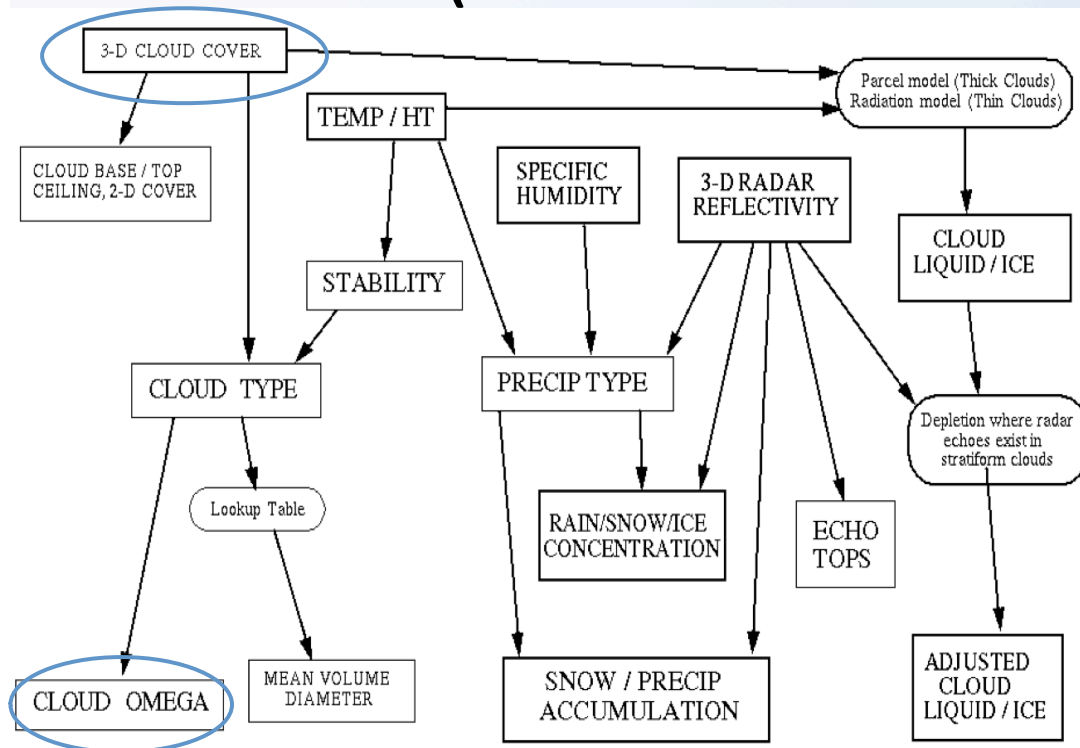
Cloud Fraction 3-D Isosurface



## LAPS CLOUD ANALYSIS

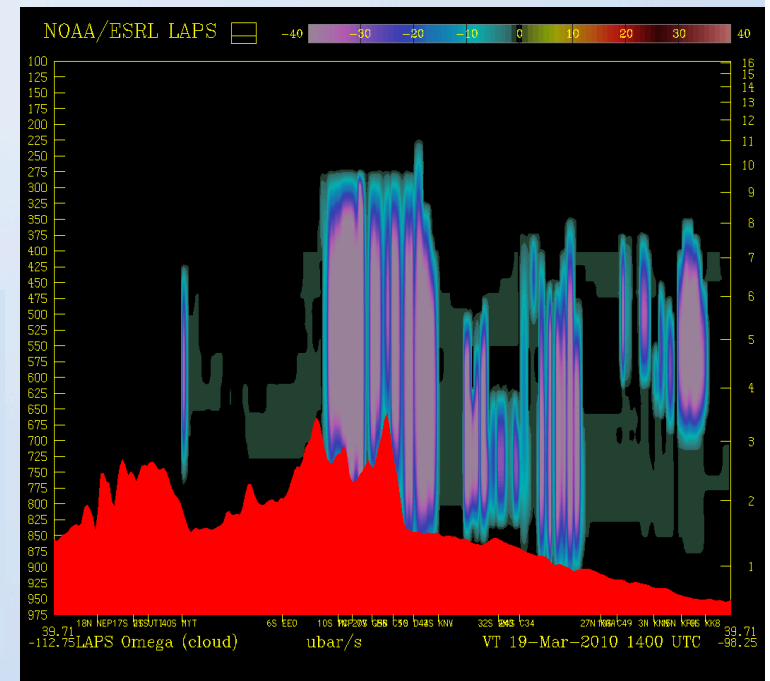


# Microphysics, Vertical Motion and Hot-Start (deriv.exe + accum.exe)

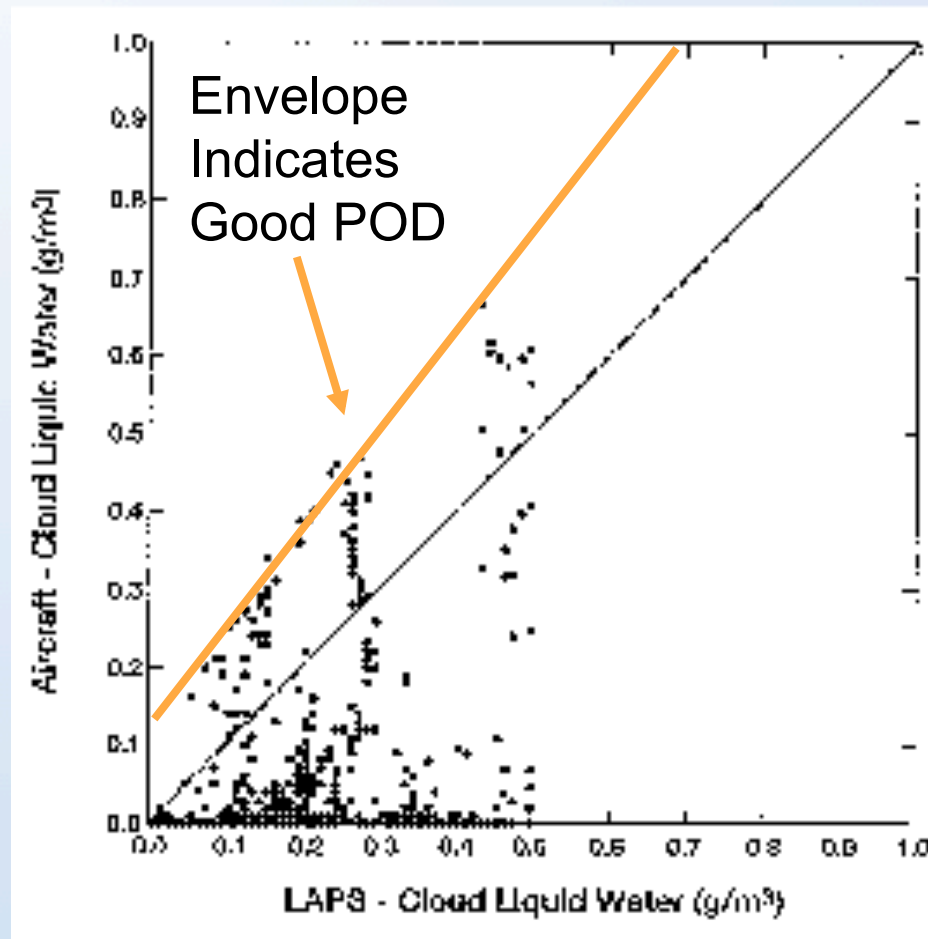


LAPS hot-start scheme  
Dramatically improves  
Very short-range forecast,  
Importance to terminal  
Scale forecasts

The hot-start scheme will be adapted into STMAS, a multi-grid variational data assimilation system with satellite, radar, conventional obs and model dynamic constraint applied simultaneously.



# Analyzed Cloud Liquid vs WISP Aircraft measurements



Scatter (FAR) due to unresolved small-scale LWC variability, otherwise good analysis of icing potential



# Balance Package

User-defined weights  $\mathbf{O}$

$$J = \sum_k \sum_j \sum_i O_V (\hat{u} - u')^2 + O_V (\hat{v} - v')^2 + O_\omega (\hat{\omega} - \omega_c')^2 + O_\Phi (\hat{\Phi} - \Phi')^2 \\ + \mu (\hat{u}_t)^2 + \mu (\hat{v}_t)^2 + \lambda (\hat{u}_x + \hat{v}_y + \hat{\omega}_p) \\ + B_V \hat{u}^2 + B_V \hat{v}^2 + B_\Phi \hat{\Phi}^2 + B_\omega \hat{\omega}^2$$

Eqn 1

Hatted quantities:  
solution increment

Primed quantities:  
pre-balanced increment

(observations),  $\mathbf{B}$  (background) are defined from known error characteristics of the first stage analysis and background model, respectively. Ideally  $\mathbf{B}$  represents the actual error statistics from the background model. Weight  $\mu$  adjusts the magnitude of the residual Eulerian time tendencies of  $u$  and  $v$  relative to the other constraints and provides a balance among the mass and momentum fields. The term  $\lambda$  is a Lagrange multiplier that becomes another unknown.  $\lambda$  will

ensure that continuity is satisfied to the limits of computational accuracy.

The Eulerian time tendencies  $u_t$  and  $v_t$  given below in Eqn. 2a and b,

$$\hat{u}_t = -(u_b \hat{u}_x + \hat{u} u_{bx} + v_b \hat{u}_y + \hat{v} u_{by} + \omega_b \hat{u}_p + \hat{\omega} u_{bp}) - \hat{\Phi}_x + f \hat{v} - D(\hat{u})$$

Eqn 2a

$$\hat{v}_t = -(u_b \hat{v}_x + \hat{u} v_{bx} + v_b \hat{v}_y + \hat{v} v_{by} + \omega_b \hat{v}_p + \hat{\omega} v_{bp}) - \hat{\Phi}_y - f \hat{u} - D(\hat{v})$$

Eqn 2b

utilize background ( )<sub>b</sub> fields so the non-linear terms become quasi-linearized with known estimates from the previous analysis step.

Subscripts x, y, and p refer to horizontal (x,y) and vertical (p) derivatives.

# Future Cloud Analysis Development

- Higher Resolution Time/Space
- Develop forward models for all data sources being used to more fully implement a variational approach
- Incorporate methodologies into STMAS & GSI
- Consider new data sources (e.g. airborne radar)
- Improve rain gauge / radar / model first guess blending for QPE



# Web Products

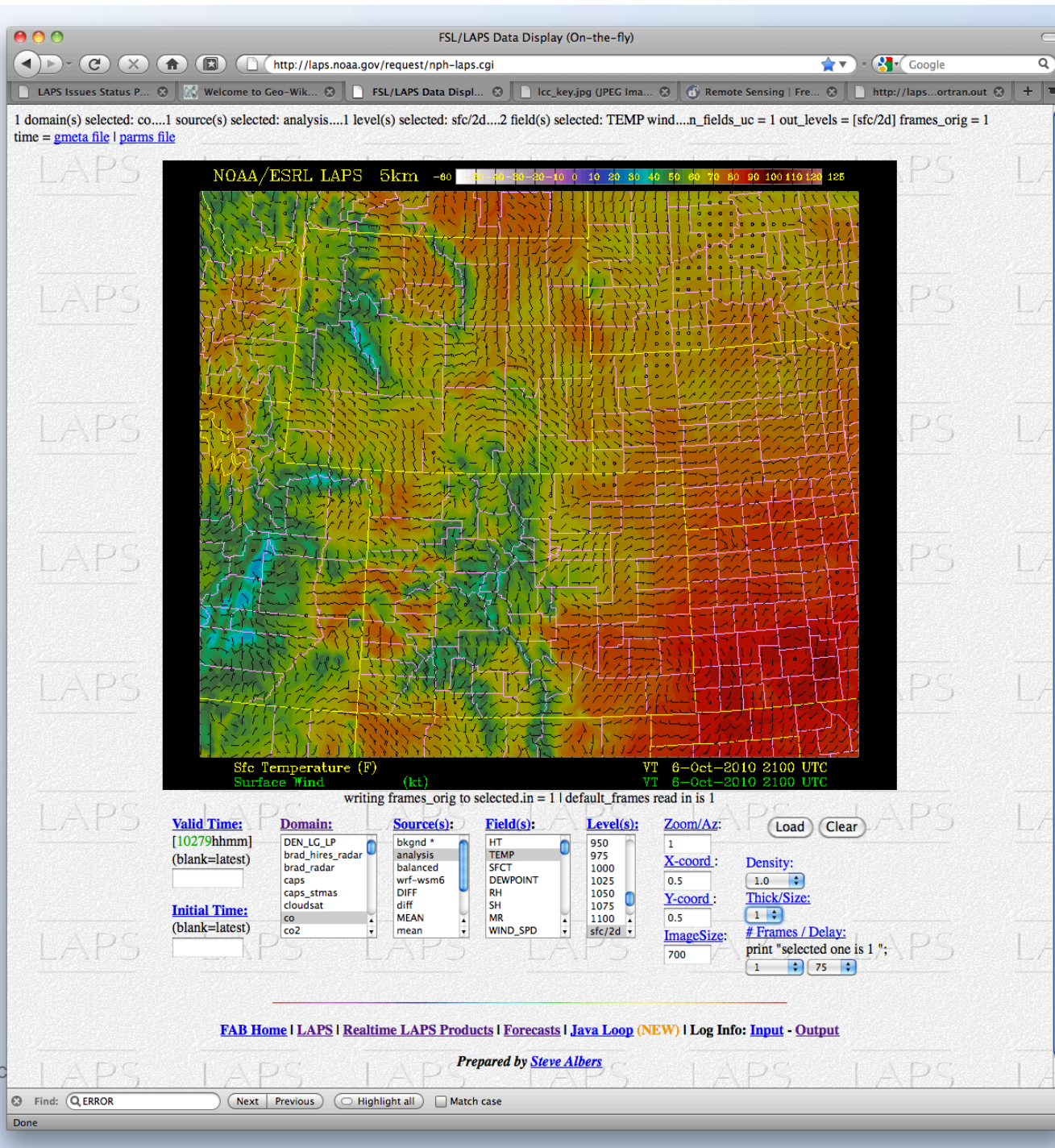
- NCL/NCAR graphics based
- Pre-Generated NCAR graphics
  - “Sched.pl -f” runs `followup_ncarg.sh` to generate GIF images
- “On-the-fly” page
  - “nph-laps.cgi” script (`etc/www`) directory
  - Can be run on a web server
  - Publication quality imagery
  - Horizontal, vertical cross sections, soundings
  - Verify/overlay model forecasts with analyses and observations
  - Difference plots (e.g. analysis vs. first guess)
  - Animations (animated GIF / Java)
  - Montages (e.g. ensemble display through time)



# "On-The-Fly" Page

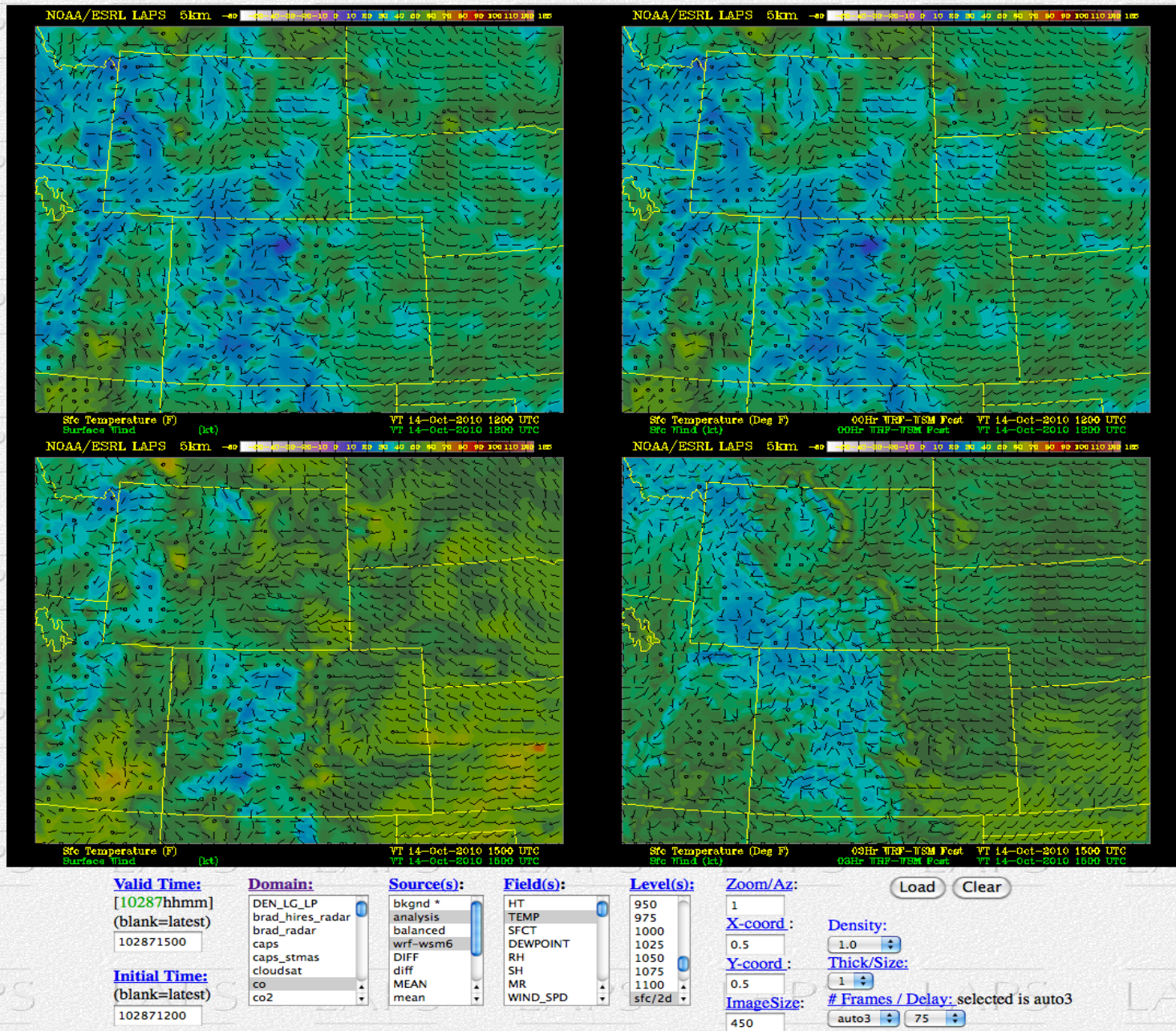


OAR/ESRL/GSD/Forecast Application  
<http://esrl.noaa.gov/gsd/fab>





# “On-the-fly” Page Montage



Oct 8<sup>th</sup>, 2010 at 5:18pm

# Forecast Applications Branch

## Local Analysis and Prediction System

# Discussion Forum

Good Afternoon Steve Albers,  
you have 1 message, and no new messages.

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LAPS Users Discussion Forum &gt; Local Analysis and Prediction System &gt; LAPS General Discussion



LAPS General Discussion

 Topics: 201  
 Posts: 478

Pages: 1 2 3 ... 11

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	Subject	Started By	Replies	Views	Last Post
	Compiling LAPS with ifort	Matt Foster	9	243	Sep 27 <sup>th</sup> , 2010 at 5:35pm By: Steve Albers
	Build LAPS with gfortran?	Matt Foster (Guest)	6	159	Sep 13 <sup>th</sup> , 2010 at 4:21pm By: Steve Albers
	Getting more S8A data	Ben Baranowski	1	52	Sep 11 <sup>th</sup> , 2010 at 4:36pm By: Steve Albers
	LAPS Hydrometeors from Level II radar data	Ben Baranowski	9	248	Sep 6 <sup>th</sup> , 2010 at 11:18am By: Steve Albers
	Compiling LapsNexrad package	Matt Foster (Guest)	1	59	Aug 27 <sup>th</sup> , 2010 at 11:04am By: Steve Albers
	wind.exe performance	Matt Foster (Guest)	6	145	Aug 23 <sup>rd</sup> , 2010 at 12:59pm By: Steve Albers
	GPS PW data	Matt Foster (Guest)	2	88	Aug 17 <sup>th</sup> , 2010 at 5:25pm By: Steve Albers
	LAPS Workshop Week of October 25-29	Steve Albers	0	46	Aug 10 <sup>th</sup> , 2010 at 6:05pm By: Steve Albers
	cloud.exe: clouds_3d	Matt Foster (Guest)	8	140	Jun 4 <sup>th</sup> , 2010 at 6:18pm By: steve albers (Guest)
	lga.exe: Interpolation problem	Matt Foster (Guest)	5	89	May 5 <sup>th</sup> , 2010 at 11:50am By: Matt Foster (Guest)
	cloud_drift ingest	Matt Foster (Guest)	2	56	May 1 <sup>st</sup> , 2010 at 1:00pm By: Steve Albers (Guest)
	GOES 13?	Matt Foster (Guest)	2	64	Apr 21 <sup>st</sup> , 2010 at 7:36am By: dan (Guest)
	Problems running lapsplot	Matt Foster (Guest)	4	60	Apr 15 <sup>th</sup> , 2010 at 1:17pm By: Matt Foster (Guest)
	lga.exe can't find libjasper	Matt Foster (Guest)	0	39	Mar 18 <sup>th</sup> , 2010 at 9:30am By: Matt Foster (Guest)
	lga.exe: Trouble reading AWIPS RUC data	Matt Foster (Guest)	7	127	Mar 17 <sup>th</sup> , 2010 at 11:05am By: Matt Foster (Guest)
	Error from lapsplot	Matt Foster (Guest)	1	54	Mar 17 <sup>th</sup> , 2010 at 11:02am By: Matt Foster (Guest)
	Compilation at CRAY machine	Erik Gregow (Guest)	0	27	Dec 21 <sup>st</sup> , 2009 at 3:18am By: Erik Gregow (Guest)
	Read surface information question	Maite (Guest)	2	58	Dec 18 <sup>th</sup> , 2009 at 3:01am By: Maite (Guest)
	lfrmpost WRF	abel (Guest)	0	25	Oct 5 <sup>th</sup> , 2009 at 7:01am By: abel (Guest)
	Aircraft radar data ingest	Chris Chambers (Guest)	1	47	Jun 25 <sup>th</sup> , 2009 at 11:59am By: steve albers (Guest)

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# Analysis software plans

- Portability
  - Intel/fort
  - GFORTRAN
  - Mac (Linux)
- Parallelization
  - MPI works with Traditional LAPS wind analysis
  - STMAS minimization routine is next
  - GPU technology
- Optimize & Vectorize serial code
- Sub-Kilometer resolution
  - Hi-res Terrain / Land Use (incorporated in balancing constraints)





# Thanks!

- More info at:  
<http://laps.noaa.gov>
- Questions / Comments?



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<http://esrl.noaa.gov/gsd/fab>